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Date: August 16, 2000

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Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of

Inventor: Yoshihiro TSUKAMURA and Takeshi FUNAHASHI

For: FINGERPRINT COLLATING DEVICE AND FINGERPRINT COLLATING METHOD

Enclosed are:

- ☒ Specification and Claim(s).
- ☒ Oath or Declaration. (Executed)
- ☒ 3 sheet(s) of drawings. (two sets)
- ☒ An assignment of the invention to Sony Corporation.
- ☒ Copy of 1 priority application(s).
- ☐ Associate Power of Attorney.

The fee has been calculated as shown below:

CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE
TOTAL CLAIMS	4-20	0	X \$ 9 \$18	\$0
INDEP. CLAIMS	2-3	0	X \$39 \$78	\$0
Fee for Multiple Dependent Claims \$130/\$260				\$0
			TOTAL FILING FEE	\$690.00

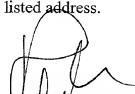
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- ☐ A Preliminary Amendment is attached.
- ☐ Verified Statement claiming small entity status is enclosed.
- ☒ Charge \$ 690.00 to Deposit Account No. 18-0013 to cover the filing fee. A duplicate copy of this sheet is enclosed.
- ☒ The Commissioner is hereby authorized to charge any fees under 37 C.F.R. 1.16 or 1.17 which may be required during the entire pendency of this application, or to credit any overpayment, to Deposit Account No. 18-0013. A duplicate copy of this sheet is enclosed.
- ☐ A check in the amount of \$ _____ cover the filing fee is enclosed.
- ☐ Charge \$ _____ to Deposit Account No. 18-0013 to cover the recordal fee. A duplicate copy of this sheet is enclosed.
- ☒ Applicant's undersigned attorney may be reached by telephone in our Washington D.C. Office at

(202) 955-3750.

All correspondence should be directed to our below listed address.

Date: August 16, 2000



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FINGERPRINT COLLATING DEVICE AND FINGERPRINT COLLATING METHOD

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a fingerprint collating device and a fingerprint collating method, and more particularly, is suitably applied to a fingerprint collating device to effect personal authentication by using the fingerprint, for example.

DESCRIPTION OF THE RELATED ART

Conventionally, there is a fingerprint collating unit for effecting personal authentication by using the fingerprint. Such fingerprint collating unit uses an image pick-up element to photograph a user's fingerprint, and produce a fingerprint image. And the fingerprint collating unit collates the photographed fingerprint image with the registered fingerprint image for collation to effect personal authentication. The fingerprint is unchanged throughout one's life and different from person to person. Therefore, the fingerprint can securely assure the personal authentication.

However, the third party may pick up the other's fingerprint from a cup or the like, for example, to falsify a fingerprint image, and enter the falsified fingerprint image into the fingerprint collating unit for the fingerprint collation. The

third party may abuse the falsified fingerprint for personal authentication.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of this invention is to provide a fingerprint collating device and a fingerprint collating method which can prevent an illicit use of the other's fingerprint.

The foregoing object and other objects of the invention have been achieved by the provision of a fingerprint collating device for collating a user's fingerprint the registered fingerprint information to effect personal authentication, comprising fingerprint reader for reading the user's fingerprint to create read fingerprint information, and to create read hysteresis information indicating that the read fingerprint information has been created, read hysteresis storage for storing the read hysteresis information, and collator for collating the read fingerprint information with the registered fingerprint information to effect personal authentication and output a result of authentication when the read hysteresis information is stored in the read hysteresis storage.

The read hysteresis information indicating that the read fingerprint information has been created is stored in the read hysteresis storage, and the read fingerprint information is collated with the registered fingerprint information to effect personal authentication when the read hysteresis information is

stored in the read hysteresis storage. Therefore, even if the read fingerprint information is improperly entered from the outside, the personal authentication is not effected, leading to prevention of an illicit use.

The nature, principle and utility of the invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings in which like parts are designated by like reference numerals or characters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a block diagram showing the configuration of a fingerprint collation system according to the present invention;

Fig. 2 is a block diagram showing the configuration of a fingerprint collating unit; and

Fig. 3 is a diagram showing a stored state of fingerprint data.

DETAILED DESCRIPTION OF THE EMBODIMENT

Preferred embodiments of this invention will be described with reference to the accompanying drawings:

(1) Overall Configuration of a Fingerprint Collation System

In Fig. 1, reference numeral 1 denotes a fingerprint collation system of the invention as a whole, in which a card reader 20 for reading or writing data from or to an Integrated

Circuit (IC) card 21 and a fingerprint collating unit 30 as a fingerprint collating device are connected to a personal computer 10. The personal computer 10 is connected to the card reader 20, as well as the fingerprint collating unit 30, via an RS-232C serial interface.

The fingerprint collating unit 30 accepts a user's fingerprint, and collates the fingerprint with either a fingerprint template (reference fingerprint data for the person for authentication) registered in the fingerprint collating unit 30 or a fingerprint template registered in the IC card 21, a result of fingerprint collation being output to the personal computer 10.

The fingerprint collating unit 30 has a plurality of fingerprint templates registered, each fingerprint template being identified by an index number N index. Also, the IC card 21 has a fingerprint template of an owner of the IC card 21 registered.

(2) Fingerprint Registration Process

When the fingerprint of a person for authentication is registered in the fingerprint collating unit 30, the personal computer 10 sends a fingerprint registration instruction Reg and an index number N index specified by the user to the fingerprint collating unit 30 in response to the fingerprint registration operation of the user.

Fig. 2 is a diagram of the fingerprint collating unit 30 as a whole. A CPU 31, a program Random Access Memory (RAM) 32, a program flash Read Only Memory (ROM) 33, and a collation controller 34 are connected to a main bus 39. The CPU 31 reads a control program from the program flash ROM 33 and executes the control program in the program RAM 32 to control the whole of the fingerprint collating unit 30.

That is, the CPU 31 receives the fingerprint registration instruction Reg and the index number N index sent from the personal computer 10 via a RS232C driver 38. And the CPU 31 controls the collation controller 34 in accordance with the fingerprint registration instruction Reg to start reading the fingerprint.

The collation controller 34 turns on an LED 41 under the control of the CPU 31 to apply an illuminating light L1 onto the bottom face of a prism 50. Then, the user puts one's finger with fingerprint face to be registered on the slant of the prism 50 firmly.

The prism 50 reflects the illuminating light L1 on the interior of the slant of prism to cause a reflected light L2 to be outgoing via a lens (not shown) provided within a lens barrel 51 to a Charge Coupled Device (CCD) 40. The prism 50 reflects totally the illuminating light L1, when there is an air layer on the outer face of the slant, while diffusing the illuminating light L1, when there is no air layer on the outer face of the

slant. Therefore, when the user puts one's finger with fingerprint face firmly on the slant of the prism 50, the illuminating light L1 is reflected at a concave portion of the fingerprint due to the presence of air layer, while being diffused at a convex portion of the fingerprint due to the absence of air layer. Consequently, the reflected light L2 results in an image which is bright in the concave portion of fingerprint and dark in the convex portion of fingerprint. The CCD 40 produces an image signal S40 by picking up the reflected light L2, and outputs the image signal S40 to an analog/digital converter 37. In this way, the fingerprint is optically read.

The analog/digital converter 37 converts the image signal S40 into a digital signal, which is binarized and output as the fingerprint image data D37 to the collation controller 34. At this time, the collation controller 34 displays the fingerprint image data D37 via the RS232C driver 38 on a monitor 11 of the personal computer 10 (Fig. 1). Thereby, the user confirms one's own fingerprint photographed to adjust the disposition of the finger with respect to the prism 50.

The collation controller 34 extracts the feature points of fingerprint (central or branch point of fingerprint pattern) from the fingerprint image data D37 to produce a fingerprint template Temp. And the collation controller 34 registers the fingerprint template Temp and an attribute Attb associated with the fingerprint template Temp at an index (address) specified by the

index number N index within the collation flash ROM 35, as shown in Fig. 3, and notifies the personal computer 10 that the registration of fingerprint has been completed (Fig. 1).

(3) Fingerprint Collation Process

(3-1) Fingerprint collation process with fingerprint template within fingerprint collating unit

When the fingerprint collation is performed by using a fingerprint template Temp registered within the fingerprint collating unit 30, the user uses the personal computer 10 to start a fingerprint collation process and input an index number N index. The personal computer 10 sends a fingerprint collation instruction Ref and the index number N index specified by the user to the fingerprint collating unit 30 in response to this.

In Fig. 2, the CPU 31 receives the fingerprint collation instruction Ref and the index number N index sent from the personal computer 10 via the RS232C driver 38, controls the collation controller 34 in accordance with the fingerprint collation instruction Ref to start reading the fingerprint.

The collation controller 34 turns on the LED 41 under the control of the CPU 31, like when registering the fingerprint, and applies an illuminating light L1 on the bottom face of the prism 50. At this time, the user puts one's finger with fingerprint face on the slant of the prism 50 firmly.

The prism 50 reflects the illuminating light L1 at the interior of the slant of prism, and causes the reflected light L2 representing the user's fingerprint image to be outgoing via a lens (not shown) provided within the lens barrel 51 to the CCD 40 which is fingerprint reading means. The CCD 40 picks up the reflected light L2 to produce an image signal S40 for output to the analog/digital converter 37. The analog/digital converter 37 converts the image signal S40 into a digital signal, which is binarized and output as the fingerprint image data D37 to the collation controller 34.

Here, when the fingerprint image data D37 is normally produced, the collation controller 34 which is fingerprint reading means sets a fingerprint accepting flag as reading hysteresis information indicating that the fingerprint has been read in the program RAM 32 which is reading hysteresis storing means.

And the collation controller 34 as collating means reads the fingerprint template Temp specified by the index number N index from the collation flash ROM 35 and collates the fingerprint image data D37 with the read fingerprint template Temp.

At this time, the collation controller 34 executes the collation between the fingerprint template Temp and the fingerprint image data D37, only when the fingerprint accepting flag has been set in the program RAM 32, but does not execute the collation when the fingerprint accepting flag has not been set in the program RAM 32. Namely, the fingerprint collating unit 30

performs the collation of fingerprint only with the fingerprint image data D37 read by the fingerprint collating unit 30, but does not perform the collation of fingerprint even if the fingerprint image data D37 is input externally. Thereby, it is possible to prevent an illicit use of fingerprint, using the falsified fingerprint image data.

After the collation between the fingerprint template Temp and the fingerprint image data D37 has been completed, the collation controller 34 resets the fingerprint accepting flag in the program RAM 32, and outputs a result of collation to the personal computer 10 (Fig. 1).

(3-2) Fingerprint collation process with fingerprint template within IC card

When the collation of fingerprint is made using the fingerprint template Temp registered within the IC card 21, the user inserts the IC card 21 into the card reader 20, and uses the personal computer 10 to start the fingerprint collation operation. The personal computer 10 sends a fingerprint collation instruction Ref to the fingerprint collating unit 30 in response to this.

The CPU 31 (Fig. 2) controls the collation controller 34 in accordance with the fingerprint collation instruction Ref to start reading the fingerprint. The collation controller 34 reads a user's fingerprint to produce the fingerprint image data D37 and store it in the collation RAM 36 under the control of the CPU 31,

like when registering the fingerprint. Herein, when the fingerprint image data D37 can be normally produced, the collation controller 34 sets the fingerprint accepting flag indicating that the fingerprint has been read in the program RAM 32.

The collation controller 34 reads the fingerprint template Temp registered within the IC card 21 via the personal computer 10, and stores the fingerprint template Temp at an index #0 in the collation flash ROM 35. And the collation controller 34 reads the fingerprint template Temp from the index #0 in the collation flash ROM 35, and performs the collation between the fingerprint template Temp and the fingerprint image data D37.

At this time, the collation controller 34 executes the collation between the fingerprint template Temp and the fingerprint image data D37, only when the fingerprint accepting flag has been set in the program RAM 32, but does not execute the collation when the fingerprint accepting flag has not been set in the program RAM 32.

After the collation between the fingerprint template Temp and the fingerprint image data D37 has been completed, the collation controller 34 resets the fingerprint accepting flag in the program RAM 32, and outputs a result of collation to the personal computer 10 (Fig. 1).

(4) Operation and Effect

In the above configuration, the fingerprint collating unit 30 accepts a user's fingerprint to produce the fingerprint image data D37. At this time, when the fingerprint image data D37 is normally produced, the collation controller 34 sets the fingerprint accepting flag in the program RAM 32.

And the collation controller 34 performs the collation between the fingerprint template Temp within the fingerprint collating unit 30 or the IC card 21 and the fingerprint image data D37, only when the fingerprint accepting flag has been set in the program RAM 32.

With the above configuration, the fingerprint accepting flag is set when the user's fingerprint is accepted to produce the fingerprint image data D37. Only when the fingerprint accepting flag has been set, the collation of fingerprint is performed. Therefore, even if the fingerprint image data D37 is entered externally into the fingerprint collating unit 30, the collation of fingerprint is not performed. Consequently, it is possible to prevent an illicit use of fingerprint, using the falsified fingerprint image data.

As described above, according to the present invention, the read hysteresis information representing that the read fingerprint information has been produced is stored in the read hysteresis storing means. When the read hysteresis information is stored in the read hysteresis storing means, the collation between the read fingerprint information and the registered fingerprint information

is performed to effect personal authentication. Even if the read fingerprint information is entered externally and illicitly, the personal authentication is not performed. Consequently, it is possible to provide the fingerprint collating device which can prevent an illicit use of fingerprint.

While there has been described in connection with the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be aimed, therefore, to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A fingerprint collating device for collating a user's fingerprint with registered fingerprint information to effect personal authentication, said device comprising:

fingerprint reader for reading said fingerprint to create read fingerprint information, and to create read hysteresis information indicating that said read fingerprint information has been created;

read hysteresis storage for storing said read hysteresis information; and

collator for collating said read fingerprint information with said registered fingerprint information to effect personal authentication and output a result of authentication when said read hysteresis information is stored in said read hysteresis storage.

2. The fingerprint collating device according to claim 1, wherein

said collator effects said personal authentication by using said registered fingerprint information supplied from external.

3. The fingerprint collating device according to claim 1 further comprising:

registered fingerprint information storage for storing said registered fingerprint information, in which said collator effects

said personal authentication by using said registered fingerprint information stored in said registered fingerprint information storage.

4. A fingerprint collating method for collating a user's fingerprint with registered fingerprint information to effect personal authentication, said method comprising the steps of:

reading said fingerprint to create read fingerprint information, and to create read hysteresis information indicating that said read fingerprint information has been created;

storing said read hysteresis information in read hysteresis storing means; and

collating said read fingerprint information with said registered fingerprint information to effect personal authentication and output a result of authentication when said read hysteresis information is stored in said read hysteresis storing means.

ABSTRACT OF THE DISCLOSURE

A fingerprint collating device and a fingerprint collating method which can prevent an illicit use of fingerprint. The fingerprint collating device includes fingerprint reader for reading a user's fingerprint to create read fingerprint information, and to create read hysteresis information indicating that the read fingerprint information has been created, read hysteresis storage for storing the read hysteresis information, and collator for collating the read fingerprint information with the registered fingerprint information to effect personal authentication and output a result of authentication when the read hysteresis information is stored in the read hysteresis storage.

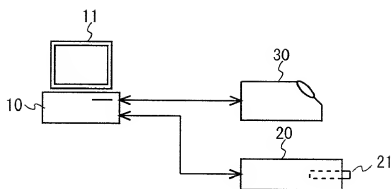


FIG. 1

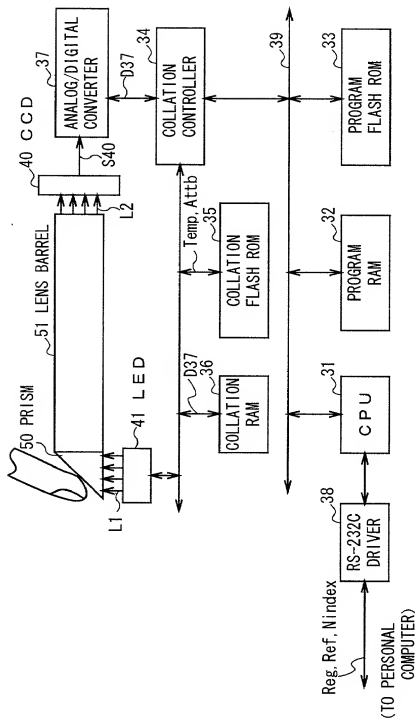


FIG. 2

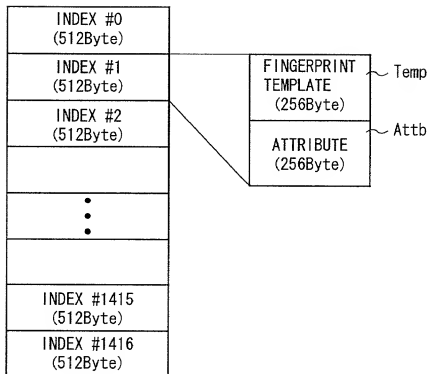


FIG. 3

Attorney's Docket No. SON-1889

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
English Language Declaration

As below named inventors, we hereby declare that:

Our residence, post office address and citizenship are as stated below next to our names.

We believe we are the original, first and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled
FINGERPRINT COLLATING DEVICE AND FINGERPRINT COLLATING METHOD

the specification of which

(check one)

is attached hereto.

was filed on _____ as

Application Serial No. _____
 and was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent of inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>P11-231683</u>	<u>JAPAN</u>	<u>18/08/1999</u>	<u>X</u>	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)		
_____	_____	_____	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)		

We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 and 1.63(d) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status)
_____	_____	(patented, pending, abandoned)

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Attorney's Docket Number: SON-1889

English Language Declaration

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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(Supply similar information and signature for subsequent joint inventors.)